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DISEASES

OF THE

SPINAL MARROW.

BY

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DISEASES OF THE SPINAL MARROW.

From the posterior part of the mésocéphale to the second lumbar vertebra, in some instances not so low, there extends (the greater part of it in the spinal canal) a cylindrical cord, slightly flattened upon its anterior and posterior surfaces, varying in dimensions and other particulars in different stages of its course. That part of this cylinder which lies between the mésocéphale and the first cervical vertebra is called the medulla oblongata; the remaining portion is the spinal marrow, which, however, is perfectly continuous with the former; nor does there exist any real or natural division between them, beyond that which difference of size and form indicates.

Viewed upon its surface, the spinal marrow will be found to be divided into six portions or pillars, extending throughout its whole length. A fissure on the anterior surface, and a similar one on the posterior, primarily divide the cord into two equal portions, applied to each other along the middle line. Each of these is subdivided into three, by two fissures seen on the lateral surface of the marrow, and the position of which is indicated by the emergence of the anterior and posterior branches of the spinal nerves from them. These columns extend upwards to the medulla oblongata, where the distinction is more obvious, as well from the difference of form of the bodies of which that portion is composed, as from the greater depth of the intervening tissues. The anterior columns are continued up into the *corpora pyramidalia*, but not until at a point about an inch and a quarter distant from the inferior margin of the pons, a series of fibres from the pyramid of one side crosses over, passing obliquely upwards to the other, interlacing with a similar set coming from that side, and thus a true decussation takes place. The extent of this decussation is generally considered as from three to five lines, and an equal number of fibres or bundles may be seen by gently separating the pyramids from each other along the median fissure after the pia mater has been removed. It must not, however, be supposed that all the fibres of the pyramid of one side decussate with those of the other; the decussation is formed only by the most internal fibres of both sides, as very clearly described and delineated by Mayo, and is to be regarded as only partial, being somewhat though not exactly analogous to that which takes place in the optic commissure.* The fibres of the corpora pyramidalia are distinctly seen to pass beneath the superficial transverse fibres of the pons, and diverging, are found to enter into the internal and inferior part of the crura cerebri.

The posterior columns of the spinal marrow are continued upwards under the name of *corpora restiformia*; they constitute a considerable portion of the medulla oblongata, diverge to form the lateral boundaries of the fourth ventricle, and may be traced partly into the crura cerebelli, and partly into the crura cerebri.* The middle column, limited in front and behind by the fissures which respectively give origin to the anterior and posterior roots of the spinal nerves, passes up as high as the inferior extremity of the oval body, (*corpus olivare,*) which on each side is interposed between the corpus pyramidale and corpus restiforme.

In those regions in which the spinal marrow gives off the nerves to the extremities, its dimensions are greatest, a constant relation subsisting between the development of these parts and the size of that portion of the marrow with which their nerves communicate. As high as the second cervical vertebra the cervical enlargement commences, it gradually increases, and after a short course as gradually diminishes; its greatest breadth corresponding, according to Meckel, to the situation of the fifth cervical nerve. In the dorsal region the circumference of the marrow is much diminished, and continues as far as the ninth dorsal vertebra, a little below which the lumbar swelling commences, and extends from the point of origin of the first lumbar nerve to that of the third sacral. The gradual diminution of this enlargement leads to the inferior extremity of the spinal marrow, which is in general fusiform, but sometimes swollen or bulbous.

The greatest proportion of the spinal marrow is composed of white substance, which in the very recent subject is firmer than that of the brain, but softens and almost liquefies with great rapidity. Unlike that of the brain, the grey substance is internal and often very indistinct in the human subject; it is composed of two crescentic portions, situated in the great lateral divisions of the marrow, whose convexities are directed towards each other, and connected by a transverse horizontal portion. This arrangement of the grey substance presents some slight variations in each of the three regions of the spine.

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* Sir Charles Bell has lately described a decussation of the fibres of these posterior columns, similar to that of the anterior columns; it takes place, according to him, just before the columns separate to enclose the fourth ventricle.—Vid. his paper in the last part of the Phil. Trans. for 1834,

The meninges of the spinal marrow differ but little from those of the brain. The non-adherence of the dura mater to the parietes of the spinal cavity, the absence of folds or processes extending into its cavity, and of sinuses ramifying between its laminæ, are obvious points of difference from the cerebral dura mater. On the sides it is perforated by a number of foramina, corresponding to the anterior and posterior roots of the nerves, from which a prolongation is continued which forms a canal for the compound nerve that results from the junction of the two roots. The spinal pia mater is evidently much stronger, thicker, and less vascular than that of the brain; it is condensed cellular membrane, and terminates below in a filiform prolongation, which is inserted into the posterior surface of the coccyx; externally it is continued over the nerves, contributing to the formation of the neurilemma. The arachnoid, like the other two membranes, is continuous with that in the cranium, but does not exhibit any obvious difference from it. Its visceral layer is connected with the pia mater by a very fine cellular tissue, so loose as to allow of the separation of the two membranes to a considerable extent, forming a space called the subarachnoid cavity. A little external to the orifices for the exit of the nerves, the arachnoid forms little culs-de-sac, extending nearly to the ganglia of the posterior roots. During life, and shortly after death, the arachnoid and pia mater are naturally separated from each other by a fluid which is likewise found between these membranes on the surface of the brain. Majendie, who was the first among the moderns to notice the existence of this fluid, has named it the *cephalo-spinal fluid*, and believes that it exists in such quantity during life as to maintain both layers of the arachnoid in contact with each other. To see this fluid satisfactorily it must be examined either in living animals or in ones recently dead. Some months ago, the writer had an opportunity of examining it in a horse, in which a considerable portion of the lower part of the dorsal region of the spine had been opened within ten minutes after the animal had been knocked down. The dura mater was perfectly tense, and on making a minute puncture into it a fine stream of clear limpid fluid issued forth to a considerable distance; when this puncture was enlarged, a quantity of limpid fluid was freely discharged. We have already given an abstract of the principal particulars respecting this fluid in the article PSEUDO-MORBID APPEARANCES, to which we beg leave to refer.

The ligamentum denticulatum is a structure peculiar to the spinal marrow, and consists of a vertical portion which adheres to the pia mater, between the anterior and posterior roots of the nerves, above anterior to the spinal accessory nerve, but below, nearer to the posterior than to the anterior roots of the cervical nerves, and of a horizontal portion, viz. its dentated processes of a triangular form extend transversely between the pia mater and dura mater; their bases adhere to the vertical portion on the former, and their apices are inserted into the dura mater; their number is estimated by Meckel at twenty. Anatomists are undecided whether this ligament belongs to the fibrous system, or is merely a continuation of the pia mater.

The vascular system of the spinal marrow ought to be carefully attended to by every pathologist. The arteries which ramify in the immediate vicinity of the spinal canal, send in branches through its numerous foramina: in the neck, the deep cervical artery—in the back, the intercostals—in the loins, the lumbar arteries—all send numerous ramifications to the interior of the spine. From the vertebral or from the basilar, arise the spinal arteries, of which the two posterior are the largest; they run down along the posterior surface of the spinal marrow on the pia mater, nearly parallel to each other, anastomosing freely, as far as the lumbar region. The anterior spinal arteries are smaller, likewise two in number; they soon unite, and form a single trunk, which follows the course of the anterior median fissure to the extremity of the marrow, and in its passage downwards sends branches outwards which communicate with their posterior arteries. The venous system of the spinal region, remarkable for its complexity, has been fully described by Dupuytren, Chaussier, and Breschet. It may be divided into an external venous plexus, which, though deep-seated, is situated along the outer surface of the bony canal, and communicates with the superficial veins, and an internal plexus, which is found in the interior of the canal, in immediate connexion with the spinal membranes. These veins are destitute of valves, and anastomose most freely with each other, forming very complicated venous networks around and within the canal. Breschet speaks of a delicate vein which is to be found in the centre of the spinal marrow; its existence, however, is certainly not constant. The spinal sinuses are found between the dura mater and posterior surfaces of the bodies of the vertebræ on each side of the posterior common vertebral ligament. They are two in number, and communicate above with the internal jugular, externally with all the veins of the several spinal regions; internally with each other by transverse branches, which, passing between the posterior ligament and the bone, receive the veins, which emerge from the bodies of the vertebræ; these sinuses extend down to the sacral canal.

The nerves which pervade, in greatest number, the human body, are connected with the spinal chord, and are each of them formed by the union of the two roots, which emerge from the lateral fissures. Each root arises by a number of filaments, which afterwards unite to form a bundle; so that a spinal nerve, properly so called, is only that which is formed by two bundles or roots, an anterior and posterior, emanating from corresponding lateral the posterior is almost always the larger, and is further distinguished from the anterior by the fact that a ganglion is formed upon it just before it forms a junction with the anterior root. But at the upper part of the spinal marrow and at the medulla oblongata, we find nervous filaments which seem to be connected to the middle column, although much obscurity still hangs over their precise origin; nor can they be said to be situated midway between the roots of the upper cervical nerves, for they are nearer to the posterior, and the inferior filaments are more posterior than the superior. These filaments go to form a nervous trunk, which leaves the spinal canal and enters the cranium, and then passes out of that cavity at the foramen lacerum posterius, close to, although passing through a separate perforation of the dura mater, the par vagum and glosso-pharyngeal nerves. The nerve is called *nervus accessorius ad par vagum*, and is one of a class of nerves, which, according to the views of Sir C. Bell, presides over those motions which immediately or remotely have reference to the function of respiration.

When we find that all the nerves that supply a limb come from the spinal marrow, and that that limb receives nerves from no other source, it is reasonable to infer that that portion of the spinal cord with which the nerves are in immediate connexion, presides over the sensation and motion with which the limb is endowed: and when we observe that destruction of that part of the marrow by disease or injury is followed by a loss of sensation and motion in the limb, we have the strongest argument in support of this opinion. But again, it is observed occasionally that sensation is destroyed while the power of voluntary motion remains unimpaired, or vice versâ; and we are thus led to inquire whether these two functions are not derived from distinct sources; and seeing that the nerves which are the conductors of sensation and motion are compounded of two distinct bundles, the experiment of a division of these is very naturally suggested. The result of the irritation or division of these roots, as ascertained by Bell, Majendie, and more recently by Muller,[*] are a convulsive motion, or palsy if the anterior roots be the subject of the experiment, and indications of pain or insensibility if the posterior. Hence it seems now very generally admitted that the former of these roots, or that column of the spinal marrow in which they are implanted (the anterior column), presides over voluntary motion; and the posterior roots, or posterior column of the marrow, over sensation.

The opinions, however, of a physiologist who has founded his observations on such minute anatomical researches as Bellingeri, demand some notice. Bellingeri admits the existence of six columns in the spinal marrow, of which he denominates the anterior, Cerebral columns, the lateral, Restiform columns, and the posterior, Cerebellic columns. He describes the grey matter and the fissures pretty much as they have been described above. As to the origins of the spinal nerves, however, he differs from most other anatomists: according to him each root has three points of origin, which are seated in the grey matter as well as in the white. Thus he finds that the anterior roots consist of three sets of filaments, severally arising from the white matter of the anterior or lateral columns and likewise from the anterior portion of the grey matter; and the posterior of a similar number coming in greatest part from the posterior portion of the grey matter, from the lateral columns and also in very small proportion from the white matter of the posterior columns. Bellingeri does not admit the isolated character of the functions of the anterior and posterior roots, such as is claimed for them by Bell. He conceives that the anterior roots preside over voluntary motions by virtue of those filaments which come from the anterior columns, and over the involuntary and instinctive motions by virtue of the filaments from the middle columns. The posterior roots, on the other hand, preside over the tactile sensibility through their large supply of filaments from the grey matter, but from the other filaments they, like the anterior, influence the voluntary as well as the involuntary or instinctive motions.[*]

The observation of a few anencephalous fœtuses, which have lived and breathed, and exhibited sensation and voluntary power—of decapitated animals, in whom life continues for some time—or of animals in whom the brain has been removed without decapitation, is sufficient to prove that the spinal marrow can perform a part in the control of sensation and voluntary motion, perfectly independently of the brain. Moreover, it appears that the upper parts of the spinal marrow are perfectly independent of the lower; for, let it be divided in any region, and the parts supplied from the marrow below the section will suffer, while those connected with that portion which is above the section remain unimpaired in function.

The question as to how far the spinal marrow influences the functions of respiration, circulation, and the development of animal heat, has attracted a good deal of the attention of physiologists. Although we cannot point to the precise portion of the marrow which has reference to these functions, there can be no doubt that it does exercise an influence over them. That respiration ceases gradually upon dividing the spinal marrow above the origin of the phrenic nerve, and that life is instantaneously destroyed by its division opposite the second cervical vertebra, have been frequently proved by experiments on animals, and by the effects of curvatures in the upper part of the cervical region of the spine, and of accidents. These facts, coupled with those before noticed respecting the continuance of respiration where the brain was congenitally absent or removed, clearly exhibit, to use the words of Sir Charles Bell, "the importance of the spinal marrow to the act of breathing, and point to the upper part of the column, the medulla oblongata, as particularly the seat of this power."

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[*] The works of Bellingeri on the spinal marrow are, 1. His treatise De Medulla Spinali, printed at Turin in 1823. 2. Experimenta in Nervorum Antagonismum, 1824. 3. Experimenta Physiologica in Medullam Spinalem, from the Memorie della Reale Academia della Scienze di Torino, tome xxx. 1826. 4. Ragionamenti, Sperienze, ed Osservazione Patologische comprovanti l'Antagonismo Nervoso, Torino, 1833. The reader will find an excellent analysis of Bellingeri's doctrines in the Edin. Med. and Surg. Journal, number cxxi. for October 1834. But he will do well also to peruse Magendie's observations on them in the 7th chap. liv. v. of Desmou-

The exact degree of influence which the spinal marrow exerts over the circulation is not so easily ascertained, in consequence of the mutual dependence which this function and that of respiration have on each other. However, it is well known that the heart's actions continue after division of the spinal marrow in any part of its course, but that it ceases more rapidly in proportion as the division is effected high up; even the immediate destruction of the whole marrow, which produces sudden paralysis of all the muscles of the body, does not cause an immediate cessation of the action of the heart, that organ still continuing to act, although feebly and irregularly.[*] That the capillary circulation of a part should be affected by destruction of that portion of the marrow from which it derives its nerves, might be inferred from the extent to which the common sensibility is destroyed by that experiment, and is moreover confirmed by the special observations of physiologists. We may, therefore, conclude that the integrity of the circulation generally has no immediate dependence on the spinal marrow, but is, in a great degree, influenced by it; that the heart can act without the spinal marrow, but that it likewise is not altogether independent of it.

Seeing, then, that respiration and circulation are so connected with the spinal marrow, we cannot err in concluding that the perfect condition of the function of calorification, whatever be its immediate source, must be, to a similar extent, dependent upon it, or, at least, will be impaired in a degree and to an extent proportionate to the destruction or injury of the marrow. This view is especially borne out by the results of certain pathological conditions, as will appear in the course of this article.[†]

The abnormal states of the spinal marrow are not so numerous as those of the brain, whether we take into account their congenital malformations or morbid conditions. As regards the latter, it seems, upon a fair consideration of all the facts hitherto collected, that those of the brain predominate; and considering the greater vascularity of that organ, its proximity to the surface, the close adhesion of its fibrous covering to the interior of its bony case, and, in fine, the part which it plays in, or the connexion which its functions have with, the phenomena of mind, we cannot but accede to the justice of this conclusion.

Passing to the consideration of these conditions, we shall first notice the congenital malformations, to little more than a bare enumeration of which our space restricts us. Total absence of the spinal marrow has been frequently observed accompanying acephalous or anencephalous monstrosities, but never otherwise. To this form of monstrosity Beclard has given the name of *amyélie*. It is a question whether its absence is attributable to a real defect of the development of the organ, or to its destruction while yet in a state of great delicacy by the formation of a dropsical effusion either around it, or in the canal or ventricle which exists in it at an early period of its development. Cases of this deficiency are recorded by some writers as having reached an advanced period of uterine life.[*] One of the most complete cases of this kind is recorded by Lallemand. The fœtus had firm flesh, and the epidermis was sound; the testicles were situated at the orifices of the inguinal canals; the motions of the child were distinctly felt by the mother before birth; and, judging from the size of the limbs and the declaration of the mother as to the duration of her pregnancy, it was concluded that the fœtus had reached the period of between seven and eight months[‖]; yet it had neither brain, cerebellum, nor spinal marrow.[†] The spinal marrow is, moreover, found in various degrees of imperfection, constituting the *atelomyélie* of Beclard. These defects of form are thus enumerated by Ollivier:[‡] 1. the malformation of various kinds of its upper extremity when the brain is absent, or when a variable portion of the upper part of the trunk is wanting; 2. its division, to a greater or less extent, into two portions; 3. its double form, as in cases where the spine is single to a certain extent, and then bifurcates at one extremity either to support two heads, or to form two trunks separated below and reunited above; 4. varieties in its length and breadth; 5. the existence of a canal in its interior; 6. its congenital dropsy, (*congenital hydrorachis,*) which in general is accompanied with an accumulation of fluid in the meningeal cavity of the spine.

Of all these varieties of congenital defect the last is that which is most frequently presented to the notice of the practitioner. The dropsy of the spine, called *hydrorachis*, consists of an accumulation of fluid in the substance of the spinal chord, in the subarachnoid cavity between the arachnoid and pia mater, or in the arachnoid sac. It very frequently happens that there coexists with this disease a congenital deficiency of the posterior portions of the vertebral rings—the spinous processes and vertebral laminæ being absent—for a variable number of vertebræ. Hence the term hydrorachis has been constantly confounded with that of *spina bifida*, which merely has reference to the incomplete state of the bony canal. It cannot be denied that hydrorachis, or a superabundant quantity of fluid, may exist in the spinal cavity without the osseous deficiency; but it will be always important for the practitioner to remember that a natural fluid exists in this canal before he pronounces with certainty on the morbid character of an affusion. When a congenital hydrorachis, strictly so called, (or, as J. P. Frank terms it, *hydrorachia incolumis*,*) exists, it is generally only part of a dropsy affecting the whole cerebro-spinal axis, and therefore its symptoms are those of congenital hydrocephalus in an aggravated form, sense and motion being affected to a greater degree, and its treatment will be to be conducted on a similar plan. But that form of hydrorachis which is found along with a deficiency of the vertebræ (*hydrorachia dehiscens* of Frank) we decidedly think to be, in the majority of cases, an accumulation which the absence of the natural resistance from the posterior wall of the spinal canal allows to take place, and therefore this defect constitutes the essence of the peculiar affection under consideration. The presence, therefore, of this congenital defect is generally if not always indicated by the existence of a tumour proportionate in extent to the number of defective vertebræ, prominent in one or more regions of the spine. Such a tumour may occur in any region of the spine; but it is most frequently found in the lumbar region, next in the sacral, rarely in the dorsal, and least of all in the cervical; it may exist in two regions at the same time, or may occupy all the three regions, the whole spine being bifid. In the cervical region, spina bifida generally coexists with an open condition of the cranium posteriorly, resulting, as Isid. Geoffroy St. Hilaire remarks, from a sort of "*spina bifida cranien.*" There is a free communication between the tumour or tumours and the rest of the cavity of the spine, or even of the cranial cavity, as appears from the diminution in the size of the tumour produced by pressure, or by an alteration in the position of the infant, for when it is in the erect posture the tumour is tense, but if the head be placed lower than the rest of the trunk it becomes flaccid. It is said that respiration also causes remarkable changes in the tumour, that it swells during expiration, and falls during inspiration.† The coverings of these tumours vary, sometimes including the skin, and, when the fluid is accumulated in the marrow, the pia mater; but the dura mater and arachnoid —that is, one layer of it—will constantly be found among its coverings. The condition of these coverings is also variable, the skin being either sound, thickened, ulcerated, almost gangrenous, or covered with fungous growths or tufts of hair; and the membranes may likewise be congested or thickened. The fluid itself is generally of the same characters as that of hydrocephalus; it may vary in quantity from a few ounces to six or seven pints, and has been found to occupy various situations, of which Andral enumerates the following:—1. in the cavity of the arachnoid; 2. between the arachnoid and dura mater; 3. between the arachnoid and pia mater; 4. between the latter membrane and the osseous parietes of the spinal canal; 5. in a canal formed in the spinal cord; 6. in a cyst situated outside the dura mater, which latter, as well as the other membranes, was perfectly free from alteration.* Sometimes serous cysts filled with clear fluid have been found in the tumour. Fleischmann† reduces the defects of the vertebræ to three classes:—1. when the whole vertebra, body as well as processes, is divided; 2. where the lateral arches are imperfectly developed; 3. where, although the lateral arches are developed, they are not united. Of these the first and third are rarely observed. Lastly, the condition of the spinal cord demands attention. Otto says, "In the most severe forms the spinal marrow is entirely wanting, and we find merely the membranes fallen together, usually slit at one or more spots, or even more or less degenerated and adherent to each other, forming sometimes a closed sac filled with lymph."§ In the more ordinary cases it is, according to Ollivier, most frequently sound; but Meckel thinks otherwise, and that it is more frequently altered either in situation, being found in the cavity of the tumour, or in structure, being softened or reduced to a pulp and diminished in size, and sometimes imperfectly divided into two parts, or spread out into a kind of membrane. The nerves undergo some alteration in their mode of distribution. Sometimes the posterior branches do not pass beyond the tumour, but are distributed upon the internal surface of the walls of the tumour, and terminate there: in some cases they form a nervous network in their ramification on the internal surface of the tumour.||

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[*] Vide Brachet, Recherches Exp. sur le système nerveux ganglionnaire.

[†] The reader who may be favourable to the doctrine of the *localization* of the functions of the cerebro-spinal axis will find a *resumé* of that doctrine, exhibiting the precise portions of the marrow which preside over the various functions of all parts, in M. Serres' work, 'Sur le Cerveau dans les quatre

[*] *Ollivier*, sur la Moelle Epinière, vol. i. p. 139.

[†] Observations Pathologiques propres à éclairer plusieurs points de Physiologie. See also a well-observed case by Morgagni, epist. 48. § 50.

This affection is for the most part fatal in its termination, and has hitherto been deemed almost incurable, but very few cases having either recovered or been ameliorated by treatment. The lower limbs are generally paralyzed, as well as the bladder and rectum, and sometimes there are convulsions and hydrocephalic symptoms. The hopelessness of a cure is of course increased, when, as is not unfrequently the case, there are other congenital defects, as deficiency of the abdominal walls, extroversion of the bladder, imperforate anus, &c. &c.

The duration of the life of the infant will depend on the size of the tumour—the larger the latter is, the shorter will be the former.

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* De Curandis Hominum Morbis, tom. vi. p. 374.

* Anat. Pathol. by Townsend, vol. ii.

† De vitiis congenitis circa thoracem et abdomen. Erlangæ.

‡ Vid. a case of this kind by Mr. Stafford, in his work on Injuries and Diseases of the Spine, p. 48.

§ Path. Anatomy, by South.

On the other hand, however, it is abundantly proved that a state of integrity of all the functions may occasionally exist even with a tumour of considerable size, for many instances are recorded of children living several years, and even arriving at the respective ages of 17, 18, 19, 20, 21, or even 50 years, with such tumours. If the tumour burst suddenly, death almost certainly will immediately result, preceded by violent convulsions; and the same consequence is apt to follow the opening of the tumour by cutting instruments, even where its evacuation is effected slowly.

Various plans of treatment have been proposed by surgeons to remove or remedy this congenital defect. The application of a ligature round the base of the tumour, pressure by a truss, (*Benjamin Bell,*) the introduction of a seton, counter-irritants, (*Richter,*) have been justly discarded. Compression and puncture were originally proposed by Mr. Abernethy, and have been since successfully carried into effect. Compression was devised by Mr. Abernethy, from the idea that it would supply that which was wanting in consequence of the incomplete state of the vertebral canal. This, however, is only a palliative remedy, and requires tō be constantly kept up in order to prevent the increase of the tumour. Sir A. Cooper applied pressure by means of plaster of Paris fitted to the tumour, and maintained by a roller applied with a moderate pressure round the waist. This was removed after a time, and its place supplied by an umbilical truss, which answered every purpose, and kept the tumour entirely within the channel of the spine.* Mr. North, so well known to the profession by his work on Infantile Convulsions, has related to us an equally successful case which occurred in his practice. The subject of it, a girl, is now arrived at adult age, and able to perform the duties of a servant in a family in London.

The plan of treatment by puncture also has been successful in the hands of Sir A. Cooper. The tumour was punctured by a needle, and its contents evacuated every fourth day, and a roller applied round the body: after some time the walls of the tumour became solid, and the child was relieved from all inconvenience. This mode of treatment seems decidedly to be the only one likely to effect a permanent cure by the final consolidation of the tumour, and it is evident that its success will in great measure depend on the degree of perfection of the spinal marrow itself.

We may here allude to that peculiar yellow discoloration of the spinal marrow and of its serous covering which M. Lobstein has noticed in fœtuses at an early period, and which he has denominated "*kirronosis.*" The colour is a golden yellow, and does not seem to be attributable to any particular extraneous colouring matter, for it resisted repeated washings and a prolonged immersion in alcohol. M. Lobstein has not found this discoloration at a more advanced period of life, and has always noticed it in the nervous tissue and serous membranes.*

The morbid conditions of the contents of the spinal canal may be discussed in the following order:—1. those of the spinal meninges; 2. spinal effusions; 3. the morbid states of the spinal marrow itself.

1. *The morbid states of the spinal meninges.*—The membranes of the spine are so similar to those of the brain in the healthy state, that it is natural to expect their diseases should closely resemble each other. As in the case of the cerebral membranes, we rarely find one of the spinal coverings acutely affected without the others being more or less implicated. The anatomical characters of acute spinal meningitis may be thus enumerated:—increased arterial vascularity of the meninges and of the tissues immediately in the vicinity of them; slight increase of thickness of the dura mater, and an exudation of lymph upon the surface of the arachnoid, or, according to Ollivier, more frequently between the arachnoid and pia mater, so as to give the marrow the appearance of being enlarged in circumference. Sometimes there is purulent effusion between these membranes, or considerable serous effusion into the arachnoid cavity, while that membrane itself is rendered opaque, probably by the thickening of the subjacent pia mater. If the arachnoid membrane appear red, it will be so from the turgescence of vessels subjacent to, not in, it, for this membrane, like the other serous membranes, does not afford any signs of red vascularity. Where there is a morbid state of the bones, local or circumscribed inflammations are observed. Lallemand,† Ollivier, and Bergamaschi,‡ relate cases in which effusion existed on the exterior of the dura mater, between it and the osseous wall of the spinal canal.

When the lymph is thrown out upon that portion of the arachnoid which lines the dura mater, it gives an appearance of increased thickness to the latter membrane, which of course will vary with the quantity of effused lymph. Adhesion of the two layers, and consequent obliteration of the sac of the arachnoid, as well as opacities of the membrane itself, often produced by a close adhesion to the pia mater, may be regarded as consequences of inflammation. Ulceration and mortification are also spoken of by some writers.

The greater number of cases of spinal meningitis occur in connexion with acute disease within the head, either antecedently or subsequently, and most frequently the inflammation spreads to the substance of the marrow itself; hence instances are rare where this affection has existed alone, and consequently those symptoms which exclusively depend on irritation of the membranes are imperfectly ascertained.

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* Med.-Chir. Trans. vol. ii. p. 323.

* Répertoire Gén. d'Anat. et Phys. fasc. i. 1826; and Ollivier sur la Moelle, &c. v. i. p. 209.

† Lettres sur l'Encéphale, t. i. p. 309.

‡ Giornale della Soc. Med. Chir. di Parma. Guigno, 1810.

Pain, sometimes extremely intense, occupying a greater or less portion of the spine; rigidity, or violent spasms of the muscles of the back, occasionally producing opisthotonos, and also of other muscles, as those of the neck, upper extremity, &c.; a peculiar sense of constriction either round the neck, back, or loins, according to the part of the spine affected; rigors, more or less of exalted sensibility, or paralysis of motion; dysuria, or even retention of urine from paralysis of the bladder, and constipation of the bowels, are among the most prominent symptoms. The locality of the paralytic symptoms, as well as of the muscular rigidity, varies with the situation of the spinal disease. On the first invasion of the disease, there are generally some obscure symptoms about the patient; pains resembling those of rheumatism, attended with lassitude, and a feeling of weight about some part of the spine. The tetanic contraction is, as Ollivier remarks, particularly manifested when the patient is moved. In some instances the rigidity is continued and permanent until death, but most frequently there are remissions of a more or less complete character. Dr. Tweedie has related to us a case, the symptoms of which there is strong reason to think resulted from partial spinal meningitis. A young lady, in the advanced stage of a severe attack of fever, during which the brain had been severely affected, was seized rather suddenly with violent muscular contractions of the extremities, so that the arms were alternately thrown out from and drawn back to the trunk with great violence; while, at another, similar contractions of the muscles of the lower extremities occurred. These violent and irregular motions ceased almost immediately after large detraction of blood from the region of the spine, followed by counter-irritation, and the patient completely recovered. In another case that occurred to Dr. Tweedie, in which the early symptoms assumed the form of cerebral fever, the muscles of the lower jaw became so rigidly contracted, that medicines and nourishment were with the utmost difficulty administered. The muscles of the trunk became next affected, complete opisthonotos being induced. This lady died, and on examining the spinal cord, the dorsal portion bore traces of violent inflammation; the investing membrane was intensely injected, and the substance of the spinal marrow, for the space of an inch, reduced to a softened pulpy mass.

The exalted sensibility is, according to Ollivier, a constant phenomenon in spinal meningitis, and may serve, as he thinks, to distinguish it from inflammation of the marrow itself, which is in general attended with diminished sensibility. The respiration is sometimes difficult and oppressed; the pulse preserves its regularity but gradually becomes weak, and the patient dies exhausted by the severity of the spasms, or the intensity of the pain, or from convulsions, which are sometimes accompanied with trismus. The bladder is sometimes inflamed, either in consequence of the loss of its protecting sensibility or of the acrid nature of the urine, which becomes decomposed in the bladder. The causes of spinal meningitis are not always discoverable. It may arise from disease of the bones—from violence applied to the spine externally; it may appear consecutively to a similar inflammation within the cranium, as in Dr. Tweedie's cases just related, or, as some think, it may be caused by a suppression of the menses or of a hemorrhoidal flux; it may be the effect of cold, or on the contrary of a prolonged exposure to great heat, as from the sun's rays. It is generally fatal.

Treatment.—Copious local or general bleeding is obviously indicated as the first step of the treatment. Goss recommends free and deep incisions along each side of the vertebral spines, with a view of opening the veins which communicate so freely with those of the spinal marrow. The warm or vapour bath may be advantageously employed. Ollivier recommends the application of ice along the back, on the same principle that it is used in cerebral inflammations. Counter-irritation can have but little effect except it be severe and applied over an extensive surface. For this purpose, a sinapism or blister extending the whole length of the spine, or the ointment of tartarized antimony, may be employed.

The chronic affections of the spinal meninges consist chiefly of new formations in or upon them. Such are the cartilaginous pieces found on the arachnoid, in various regions; bony incrustations, which however rarely occur, as well in the dura mater as in the arachnoid; chronic tumours of various kinds; hydatids; tubercles. The cartilaginous incrustations appear to be developed in the arachnoid. They are generally very small and numerous, nor does it appear that they are prone to be converted into bone. Several cases of one or more hydatids found in the spinal canal have been observed. Cancerous or fungoid tumours, originating externally, may send deep processes into the canal, and thus compress the marrow. Of this Ollivier gives a remarkable case.* The tumour originated externally in the neck, and a deep process from it was prolonged into the cervical portion of the spinal canal through the intervertebral foramina; the tissue external to the dura mater was for a considerable extent converted into a similar matter. There was paralysis of the arm of the same side.

The symptoms produced by these chronic growths are by no means uniform; they will vary according to the region of the spine they may be placed in, or according to the part of the spinal cord upon which they may directly press, whether anterior or posterior. Paralysis, as well of sensation as of motion, sometimes general; muscular spasm, pain in the course of certain nerves, sometimes a morbidly acute sensibility of the cutaneous surface to a considerable extent, constitute the principal phenomena resulting from their presence. It is proper to remember that a large aneurism, compressing and causing the absorption of the bodies of the vertebræ, may so find its way to the spinal cavity as to compress the marrow, and produce additional symptoms still more calculated to perplex the practitioner than those which are commonly attendant on those cases. The writer lately assisted in the examination of the body of a man who exhibited, some time before death, symptoms which seemed to depend on spinal compression. For a considerable period prior to his death, the integument of the thorax was so exquisitely tender that he could not bear the least touch; this continued till four days before death, when the integuments became perfectly insensible, except along the middle line, both anteriorly and posteriorly, where the former tenderness remained. This was a case of aneurism occupying nearly the whole thoracic aorta; the bodies of the corresponding dorsal vertebræ were completely destroyed from the pressure of the tumour. The spinal marrow in that region struck us as being peculiarly firm; and the fatty membrane, external to the dura mater, presented an unusual degree of density.

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* Page 751, vol. ii.

2. *Spinal effusions.*—These effusions vary as to their locality, and as to the nature of the effused fluids. They may take place—1. between the bony wall of the spinal cavity and the dura mater; 2. in the arachnoid sac; 3. in the space between the visceral layer of the arachnoid and the pia mater, (the sub-arachnoid cavity,) which in the healthy state is filled by the cephalo-spinal fluid of Majendie. In those situations serum, blood, pus, or air, may be effused, and thus produce symptoms analogous and sometimes precisely similar to those caused by the development of chronic growths from the membranes. Such effusions, however, may appear from other causes than those which operate directly upon the spinal meninges; the free communication between both the arachnoid sacs and sub-arachnoid cavities of the head and spine allows the fluids of one to pass to the other, and if there be cerebral apoplexy, the spinal fluid may readily be deeply coloured with blood. Pus and blood may come from chronic abscesses or aneurisms which have caused the absorption of the bodies of the vertebræ.

Effusion external to the dura mater may, as Dr. Abercrombie observes, be regarded as unequivocal evidence of spinal irritation. We have already alluded to cases of this kind related by Ollivier, Lallemand, and Bergamaschi. In that by Ollivier, the principal symptoms were opisthotonos, difficult deglutition, and coma; a red and very consistent fluid was found between the dura mater and the bony canal in the tissue situated there, with serous effusion within the membranes; and the arachnoid of the cord was covered with an albuminous layer for the extent of four inches. In Dr. Abercrombie's case, (that of a child aged two years,) the symptoms commenced with fever; after two days she was seized with violent convulsions, which lasted an hour, and were succeeded by coma; and about two hours after the first she had a second convulsive fit, never recovered. During the fits, and for some time after them, there were violent and irregular action of the heart, and a peculiar spasmodic action of the diaphragm. The eye was completely insensible, and the pulse very frequent. She had several slight attacks of convulsion, and one more severe, a short time before death, which happened thirty-three hours after the first attack. The brain was healthy; on the outer surface of the dura mater there was a copious deposition of colourless fluid, most abundant in the cervical and upper part of the dorsal regions; there was a little effusion of bloody fluid into the arachnoid sac, and the substance of the cord seemed softer than natural at the upper part.*

Serous effusions occur most frequently in the space between the arachnoid and pia mater, and in forming an opinion as to the morbid nature of them, we must be careful to make due allowance for the quantity of fluid which naturally exists between these two membranes. A case of unusual superabundance of this fluid is recorded in one of the numbers of the Journal Hebdomadaire for August, 1833, by M. Montault. The patient, ætat. 68, a porter, strong and athletic, after a fit of intoxication (not unusual,) fell rapidly into general paralysis, for which he was bled largely by leeches applied behind the ears, at the anus, and on the left side of the chest; he became delirious, and then comatose, and died on the sixth day. The body was examined fifteen hours after death; an enormous quantity of fluid was accumulated between the arachnoid and pia mater of the brain and spine. It amounted to nearly thirteen ounces in quantity, and extended into the lateral ventricles. There was no alteration in the texture of the brain or spinal cord.

Venous congestion may produce an increase of this natural effusion; but we conceive that it will often be impossible to say with certainty that it was not formed after death by the separation of the serum of the blood, and its infiltration through the coats of vessels. Increased serous effusion may also arise from any irritation in the immediate vicinity, and is found in cases of spinal curvature, or in meningitis, especially when chronic. This effusion may also occur in the arachnoid sac; and here it is impossible to say that it has not transuded from the sub-arachnoid cavity through the layer of arachnoid. It takes place under circumstances similar to those which produce that last mentioned. Both these forms of effusion are in general present, at least after death, in dropsy of the spine. We have already stated that a form of hydrorachis of a different kind from that which is connected with congenital deficiency of the bones, is frequently found in children with hydrocephalus, and in all probability is attributable to the same cause: it also frequently accompanies serous apoplexy in the adult. There is no external tumour in these cases, as may be reasonably supposed; the posterior wall of the spine being so resisting, except at its inferior extremity, where this wall is completed by a ligamentous expansion closing the sacral canal. Morgagni[*] relates a case from Genga, in which spinal dropsy of this kind manifested itself externally at the situation of this ligament. A child, aged four years, was attacked with hydrocephalus in consequence of a blow on the head. About a month afterwards a tumour appeared at the coccyx; it was opened, and the head appeared to diminish gradually in size as a large quantity of water was discharged from the puncture. Compression on the head increased considerably the impetus with which the fluid flowed from the opening; a circumstance which proved that this tumour communicated with the head, and resulted from the distension of the spinal membranes. It should be observed, however, that spinal effusion is not necessarily co-existent with hydrocephalus, for the exit of the fluid from the ventricles may be and often is prevented by the closure of the opening beneath the valve of Vieussens. Sometimes we find a viscid almost jelly-like matter effused round the cord, but this is most probably merely a post-mortem effect.

Effusion of blood into the spinal cavity, or between the membranes, constitutes the disease termed spinal apoplexy. The blood is generally found in a state of coagulum. This effusion may arise from concussion of the cord, occasioned by a fall from a great height—by a blow inflicted on the back; it is found also after death from cerebral apoplexy, hanging, tetanus,[†] hydrophobia,[‡] and in children whose death has been occasioned by difficult parturition. Sometimes a portion of the spinal marrow itself is so mixed up with the coagulum as not to be distinguished from it, in which case the hemorrhage would appear to have originated in the tissue of the marrow.

Convulsions, paralysis, sometimes a diminution, and at others an increase, of sensibility, pain in the back, are the most usual symptoms which have been observed in such spinal lesions. In a case related by Dr. Abercrombie, of a child seven days old, the symptoms were repeated attacks of convulsions with trismus, and sometimes universal tonic spasm. Death took place on the fourth day. On dissection, a long and very firm coagulum of blood was found lying between the bones and membranes of the cord on the posterior part of the whole cervical region. A case of encysted spinal apoplexy is recorded by Dr. Stroud. The cyst was an inch in length, and about half an inch in diameter; it was external to the cord, and existed at the upper part of the dorsal region on the left side. The patient died universally paralysed; the disorder, however, set in with hemiplegia, to which succeeded paraplegia, and then the palsy spread.

Purulent effusions in the spinal canal are the surest indications of inflammation of one or more of the meninges, which likewise present other characters to particularize them.

Effusions of air, constituting *pneumatorachis*, have been described by Ollivier as occurring in the spinal canal. We are not acquainted with any writer who has fully confirmed his experience on this point. Otto has met with air in the spinal canal, but, he says, not under such unequivocal circumstances as would justify him in regarding it as a morbid product. Andral does not at all allude to its occurrence. M. Ollivier says, "It is not very rare to find the lumbar portion of the meningeal canal more or less swollen by a gaseous fluid, inodorous and colourless, which cannot be attributed to putrefaction, inasmuch as I have seen it in the spinal canal of subjects recently dead, and could not discover it in a great number of others which were dead some days. I have not remarked that this disengagement of gas took place as a consequence of any particular disease."[*] The cases in which he has found air in the meningeal sheath did not present symptoms of spinal disease before death; in most of the cases the examination was made twenty-four hours after death. Billard met with a case in connexion with ramollissement of the brain and spinal marrow.

In the treatment of spinal effusions it is obvious that the practitioner must have in view not only the removal of the effusion, but also that of its cause, when that cause may happen to continue. To effect the latter object, it is evident that he must vary his treatment according to what the symptoms would indicate as the most probable cause; but to remove the effusion various remedies may be had recourse to. Sometimes it fortunately happens that the effusion is absorbed as soon as its cause is removed, and thus the application of one remedy answers a double purpose. When after accidents of the spine there are numbness and pains in the limbs, symptoms in all probability denoting an increase in the natural spinal effusion, these symptoms are often removed with a remarkable rapidity after a free local depletion or a pretty extended counter-irritation. This latter object may be effected by the usual blister, by the moxa, by setons or issues, or by frictions along the spine with any irritating applications that will produce a discharge. Of these we decidedly prefer the last; they are often purely local in their action; whereas when blisters are used, some active principle of the cantharides seems to be absorbed into the system, which though it may not be manifest from appearance of strangury, yet we cannot help thinking, produces in a similar way that aggravation of symptoms which so constantly follows the injudicious application of blisters. Mercurials may be administered with benefit in these cases, either internally or through the medium of the skin. Perfect rest, the horizontal posture, and an exemption from such causes as may disturb the circulation or respiration, are obviously indispensable.

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[*] Epist. 12, § 9, and Ollivier, loc. cit. vol. ii. p. 494.

[†] Vide Reid on Tetanus and Hydrophobia.

[‡] *A. T. Thomson*, Med. Chirurg. Transactions, vol. xiii.

[*] Op. cit. vol. ii. p. 527.

3. *Morbid conditions of the spinal marrow.* These conditions may be thus enumerated:—inflammation and its consequences; atrophy and hypertrophy; new formations in the substance of the marrow.

Inflammation of the spinal marrow, called by Harles* and Ollivier *myelitis*, is principally known by its terminations; the first stage, that of simple hyperæmia, being of rare occurrence, inasmuch as the derangement of function which it occasions is seldom sufficient to cause death. It is only in cases where death has occurred, in consequence of severe injuries, that we can expect to find the early stage of myelitis. Mr. Stafford speaks with a confidence which would imply that he has seen this early lesion; he says,—"All that can be perceived is that it is redder than natural, and that when a section of it is made its vessels are found turgid, presenting bloody points in its substance; it is usually found in this state in injuries of the spine, opposite to where the blow was received."† From all that has hitherto been collected relative to inflammation of the spinal cord, it seems pretty well ascertained that it may present the following terminations:—1. ramollissement, 2. induration, 3. suppuration.

1. *Ramollissement.*—As in the brain, anatomists are not agreed respecting the inflammatory nature of ramollissement in the spinal cord. But when the medullary substance surrounding a portion of marrow thus softened is in a vascular state, and that vascularity extends even into the softened portion; when, moreover, (as is not uncommon,) there is unequivocal evidence of meningitis, it appears to us that there are ample grounds for the opinion that the ramollissement is inflammatory; and as such cases as we have described are the most common, a great number of the cases of ramollissement may be regarded as the results of *myelitis*. The softened part is in general of a brownish colour, resembling that of the lees of wine; it is most frequently found in the lumbar region, and next in frequency in the cervical. According to Ollivier it commences in the grey substance; but that substance is itself so obscure, that we can hardly regard this opinion as fully substantiated. M. Dupuy has frequently found ramollissement of the cervical and lumbar portions of the spinal marrow in horses. So great is the softening in some cases, that the substance of the marrow has become a diffluent mass; and in raising the cord out of the vertebral canal, it gives way at that part, the upper and lower portions being only united by the pia mater. Sometimes the softening does not extend through the whole thickness of the spinal marrow, appearing in one or two cases to be accurately confined to the anterior or to the posterior columns.

Ramollissement of the spinal marrow is by no means uncommon with new-born infants; it is most frequently co-existent with a similar ramollissement of the brain. One remarkable feature in this ramollissement is that it exhales a marked odour of sulphuretted hydrogen, indicative of a rapid advance of putrefaction. Such an alteration, Billard says, is generally found in infants who had lived only a few days, respired with difficulty, and exhibited but few signs of sense and motion. Congestions of blood are in general found in the viscera of the other cavities, and there is extensive disorganization of the brain.*

It is a fact deserving of attention, that the substance of the spinal cord softens very rapidly after death: the lapse of half an hour, during which the nervous substance has been exposed to the air, often produces a manifest alteration. This we have verified on numerous occasions.

2. *Induration* may be likewise regarded as a consequence of the inflammatory action on the cord; but the inflammation appears to be of a more chronic character. The opinion is founded upon the occasional co-existence of meningitis with many cases of this alteration and increased vascularity of the cord in the neighbourhood. When the induration is considerable, Ollivier observes that the nervous substance is similar to the white of egg boiled hard. It is not vascular; and in such cases there are not, in general, obvious indications that the indurated portion had been the product of inflammation. Induration has been found by Esquirol and Pinel in the spinal marrow of epileptics; and Ollivier gives an instance of induration in the whole length of the cord in an epileptic. Billard, also, found it so extensive in a new-born infant, that the cord, after being stripped of its membranes, was able to support nearly a pound weight; in this case the meninges were lined by false membranes.†

3. *Suppuration.*—When pus is found in the spinal marrow, it is generally infiltrated through its substance. Abscess of the spinal cord is very rarely met with. Two cases of this lesion are now recorded; one by Velpeau, and the other by Mr. Hart of Dublin; a third, which was met with by Dr. Carswell, has been alluded to in the article Abscess.

The symptoms which result from inflammation of any portion of the spinal marrow, vary according to the region in which the inflamed part exists. In the early stages there will be increased sensibility, more or less pain in the back, muscular spasm, and sometimes convulsion; as disorganization proceeds, the sensibility becomes blunted, and paralysis of sense and motion ensues; sometimes there is no paralysis, but violent convulsions, and in such cases the fatal result ensues speedily. The progress of the symptoms is proportioned to the activity of the inflammation. Hence in some cases we have a train of obscure premonitory symptoms: pain in the course of particular nerves; formication; feebleness of muscles;

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* Uber die Entzundung des Ruckenmarks.

† Loc. cit.

* Maladies des Enfans, &c. pp. 614-15.

† *Andral*, Anat. Path. by Townsend, vol. ii. p. 750.

sometimes a kind of subsultus; deficient action of some internal organs which may be connected with the spinal marrow. If the seat of irritation be in the cervical region, difficulty of deglutition is among these precursory symptoms, and sometimes slight dyspnœa, which may end in complete asphyxia; but there is a remarkable variety as to the extent of the paralysis which follows disease in this region. In some cases it has extended to the four extremities, but in others it was confined to the upper, and in a few instances the paralysis affected the lower extremities only, although the upper part of the cord was most extensively the seat of disease. This fact has been regarded by some physiologists as proving that the several segments of the spinal marrow are independent of each other; though it is obvious that, if we admit the justice of this inference, a difficulty, perhaps as hard to be surmounted, will arise to account for the occurrence of paralysis from a lesion precisely similar in locality, extent, and nature. It is well known that the division of the spinal marrow in the neck of an animal leaves his four extremities powerless; and that the dislocated cervical vertebra which so compresses the marrow as, if we may so speak, to stop the nervous current downwards, paralyses every part below it. Have we not, then, as much reason to infer from these facts, that the inferior portions of the marrow are dependent on the superior, as to suppose them independent, merely from the occurrence of a few such cases as those we have alluded to? In the present state of our knowledge as to the connexion of the brain and spinal marrow, and their influences on each other, and on the organs of motion and sensibility, we are not authorized to form conclusions from data which, to say the least, are not completely established.

Sometimes the symptoms of an acute affection of the heart have manifested themselves when the irritation was seated in the dorsal region. M. Serres relates a case of meningeal inflammation and ramollissement of the cord, in which the heart's action and impulse were of such a nature, that the disease was pronounced to be dilatation with hypertrophy of the left side of the heart, which notwithstanding proved to be perfectly sound.

The lumbar region of the spinal marrow is most frequently the seat of morbid irritation: this produces all the symptoms of paraplegia, more or less perfectly paralysed limbs; formication or insensibility; tendency to the formation of bullæ; gangrene from pressure; retention and incontinence of urine; paralysis of the sphincter ani, &c. We would remark as to the nature of the incontinence of urine in these cases, that it is of that description which, paradoxical as it may appear, can exist along with retention. In some of these cases the bladder seems to be reduced to the condition of an inert reservoir, alike insensible to stimuli from within, and incapable of obeying them. Although all anatomists are not agreed as to the existence of a sphincter to the bladder, yet all admit that the *detrusor urinæ* muscle is opposed by muscular fibres, which prevent the urine from transgressing at least the limits of the prostatic portion of the urethra: we allude particularly to the muscle of Wilson, which compresses the membranous portion, and so opposes the flow of urine through it. This muscle may be paralysed, and so the passage of the urine remain free; or the sensibility of the mucous surface may be destroyed; and thus, although the muscle may be in a state of integrity, it will not act because the insensible surface will not convey the necessary stimulus. Hence, the retention of urine is always a prominent symptom from paralysis of the detrusor; and the incontinence appears whenever the patient is placed in such a position as will cause the urine to flow by its natural gravity.

To determine, then, the precise situation of the spinal inflammation, the practitioner has recourse to the early symptoms—the parts paralyzed—and a minute examination of the spine. For this last purpose he may have recourse to the method proposed by Mr. Copland, viz. passing a sponge filled with hot water along the spine: the patient will shrink as the sponge passes over the affected part. Percussion may in some instances direct us to the inflamed spot.

We subjoin two interesting cases of encysted abscess of the spinal cord, with a view to illustrate the symptoms in that stage.

The first is from the pen of Mr. Hart, a distinguished anatomist of Dublin, and is extracted from the fifth volume of the Dublin Hospital Reports.* A child, aged nine months, had been for about a month suffering from rritation of the bowels, which the parents supposed to be owing to dentition, when a lateral curvature of the lumbar portion of the spine to the right side was observed, accompanied with spasmodic twitching of the right leg and thigh. Soon after this occurrence the child was affected with convulsions, which became more frequent, and were shortly accompanied with well-marked symptoms of hydrocephalus, which, notwithstanding active treatment, proved rapidly fatal. On examination of the head there were the usual appearances from hydrocephalus. When the spine was opened, the spinal cord appeared of unusual thickness: an incision was made into it, from which some *thick purulent matter* flowed out. It was found that this matter was contained in a cyst which occupied the very centre of the spinal cord. This cyst was of an oblong form, extending from the first to the twelfth dorsal vertebræ, and was terminated by an obtuse extremity both above and below. Its diameter was about four lines, its parietes were a line in thickness, and so solid as not to collapse when the contained fluid was discharged. So completely did it occupy the centre of the cord that the medullary substance formed a tube of equal thickness on every side.

The second case is quoted by Dr. Abercrombie from Velpeau. A woman, æt. fifty-six, was affected with sudden loss of power of the limbs of the left side without loss of feeling; it soon amounted to perfect palsy; her voice became feeble and her speech embarrassed; the pulse was natural but the respiration quick. The left arm became œdematous. After four days the speech could not be understood, the pulse became feeble, with increasing general debility and stertorous breathing, and she died in a week. In the centre of the right column of the spinal cord, in the middle of the cervical portion, there was a cavity three inches long and two or three lines in diameter. It was full of a soft matter like pus, which became more consistent towards the parietes of the cavity, which were firm and about a line and a half in thickness. In the left column there was a similar disease but less extensive, being about one inch long and one in diameter, and its contents were less purulent, rather resembling ramollissement of the substance of the cord.*

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* P. 523.

As to the duration of inflammation of the spinal marrow, it may be said to vary considerably; some cases have terminated fatally in three days. It has been observed that the fatal termination is much more rapid when the dorsal region is the seat of the disease; a fact which is attributed by Mr. Earle to the greater narrowness of the spinal canal in that region. When the disease has become chronic or passed into any of the stages above mentioned, life may continue for even a very prolonged period, patients thus affected continuing to live from five to fifteen or twenty years; but the ordinary period of duration of the chronic disease is two, three, or four years.

Treatment.—There is no reason why inflammation of the spinal marrow should not be cured, but it is so very seldom met with in the first stage, that the practitioner has always to labour at a great disadvantage. In the treatment of inflammation of the spinal marrow, the antiphlogistic system must be rigidly observed; general and topical bleeding, with counter-irritation from blisters or stimulants of various kinds. Issues or setons are to be employed if the inflammation be of the chronic form. The tepid or the cold douche applied from a great height to the suspected region, has been known to be very serviceable.

In the chronic stage we may expect to confer some benefit by the application of remedies. Perfect rest in the horizontal posture is, perhaps, the most necessary and useful measure, to which we may add the adoption of means to keep up a continued counter-irritation. Close attention to the digestive organs, a continued course of purgatives, combined with a mercurial, tepid or cold bathing or the douche, will often be found useful. The strychnine, too, may be administered either internally or to a blistered surface through the medium of the skin.

The effects of concussion of the spinal marrow seem to depend very much upon chronic inflammation. Concussion sometimes proves immediately fatal; probably in consequence of the altered circulation about the spine and the general shock to the nervous system, but in general no morbid appearances can be detected. It is possible that acute inflammation may follow concussion, but more frequently there are all the signs and symptoms of chronic inflammation, which in some instances disappear without any bad consequences. At other times the concussion is followed by some permanently morbid state of the cord, which causes permanent paralysis. Sometimes these symptoms continue from the moment of the accident, but at others the patient is taken up powerless, he recovers, and in a short time gradually relapses into a worse state. General paralysis has not uncommonly succeeded to this accident.

Atrophy.—According to M. Chaussard, the spinal marrow is one of those organs in which the effects of old age become very conspicuous. This organ, he states, becomes much increased in density as age advances, and exhibits a proportionate diminution in volume as well as in length. These changes take place simultaneously with similar ones in the brain. Ollivier has confirmed these observations. The volume of the spinal roots he found in a direct ratio with that of the spinal marrow, and atrophy was appreciable in each of them. It has also been noticed by Cotunnius and Magendie that the quantity of fluid round the marrow is in these cases inversely as the size of the organ.

Prolonged inactivity will produce atrophy even to the whole extent of the spinal cord, as in two cases seen by Ollivier and Majendie; and in many cases of paraplegia the spinal cord is found in a state of atrophy at the original site of the disease which caused the palsy. The condition of the roots of the nerves in atrophy of the spinal marrow is worthy of notice. In one case the anterior roots exhibited little more than neurilemma, but the posterior did not exhibit any obvious change. In another case the roots of the lumbar nerves were reduced to threads.

Prolonged pressure, as from a displaced vertebra, or a tumour in the spinal canal, has been known to produce atrophy of the compressed part.

Hypertrophy.—This affection has been a few times noticed in the cord. It is characterized, to use the words of Andral, by the enlargement and increased firmness of the cord without the presence of hyperæmia. The cord then fills the whole cavity of the dura mater, and is closely applied to the parietes of the vertebral canal. Laennec and Hutin have observed this condition to exist in the whole length of the spinal cord. Andral found it in the cervical region of an epileptic girl.

In consequence of the induration which accompanies hypertrophy, Ollivier inclines to the opinion that it is the product of chronic inflammation.

We know of no symptoms which particularly indicate the existence of either this or the preceding affection.

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* Velpeau, Revue Médicale, 1826.

New formations in the substance of the spinal marrow.—There appears to be a perfect identity as to the nature of the morbid conditions of the brain and spinal marrow. This is in nothing better exemplified than in those chronic formations which are met with in the substance of the latter organ. All of them tend to the production of similar affections of sensibility and the power of motion, varying, like all the other diseases of this organ, according to the portion of the marrow in which these products are developed. The access and progress, however, of these symptoms are uniformly insidious and slow, and at first often simulate diseases of other organs; so that until the sensitive and motive faculties begin to be impaired, either together or separately, the practitioner is at a loss to account for the train of symptoms, or attributes them to a cause very different from the true one. These morbid products are as follow:—1. tubercle: 2. encephaloid and other tumours similar in the slowness of their growth: 3. entozoa: 4. osseous or cartilaginous tumours; but these are of rare occurrence.

Tubercle occurs more frequently in children than adults, and is much more rarely found in the lower than in the upper parts of the cord. In general, and according to Gendrin and Leveillé always, these tumours are surrounded and separated from the nervous substance by a cyst. Very often the symptoms resulting from the presence of one of these bodies are localised to one extremity, or to a particular nerve or nerves of an extremity, but in general there is very great variety in them. Epileptics are frequently found to have had tubercles in the spinal marrow.

Encephaloid tumours exhibit the same characters here as in other parts. We often find other tumours of a cellular or cellulo-vascular nature producing similar effects and similar symptoms.

The entozoa found in the spinal cord are principally hydatids and cysticerci. They are likewise found exterior to the meninges, which sometimes have seemed to have entered from some external part through the intervertebral foramina.

Having thus examined the obvious and tangible morbid changes which the spinal cord or its meninges exhibit, we shall next inquire how far a disturbance of the functions of the spinal cord may take place without the occurrence of any change of the structure visible after death.

It is by no means uncommon for the practitioner to meet with cases in which pain referred to some particular region, generally about the thorax or the abdomen, seems to have a remarkable connexion with the spine. If, in these cases, the finger be passed down along the spinous processes, making slight pressure on each, the patient will shrink when it comes to one or two particular vertebræ and will complain that the pain shoots forward from the point compressed by the finger to that where the pain was previously felt. A very slight degree of pressure is in general sufficient to produce this result; but an increase of the pressure always adds to the intensity of the pain. Sometimes there is so much tenderness that the least touch will cause pain, and when there is such extreme tenderness it is not generally confined to one spot, but extends over the whole or a greater portion of the spine; at first one would be led to consider the integuments as the seat of this extreme sensibility, but it is difficult to account for the connexion of this increased cutaneous sensibility with the pain which had previously existed; and moreover, it is equally difficult to conjecture how pressure of the kind alluded to on an osseous ring, such as the vertebra, can be communicated to a part so well protected and so far separated from the surface of the vertebral canal as the spinal marrow. That these cases very frequently, more especially when the irritation is confined to a small space, recover rapidly after the local detraction of blood by leeches, or by some counter-irritant, is a fact now pretty generally known; nor can we say that this fact serves to throw much light upon the true cause of the symptoms we have mentioned. On the other hand, instances are by no means wanting where these remedies have totally failed in removing the symptoms in question. The difficulty of finding an adequate explanation is greatest when the phenomena are slightest and confined to a very limited extent; but when the tenderness occupies the whole spine—when not only pressure from without, but even the slightest motion aggravates the pain—we are then forced to admit that the origin of the evil is in the vicinity of the spinal cord itself. It is not fair to deny the previous existence of a morbid compression or irritation of the spinal cord or of the spinal nerves at their origins, because the anatomist can detect no vestige of disease after death. It must be remembered that the spinal cord and the nerves which emerge from it are surrounded by a venous anastomosis of remarkable complexity;—these veins do not possess valves;—that they communicate freely with the superficial veins and with the numerous muscular veins in the region of the back. That respiration exerts a considerable influence on the venous circulation has been long since fully proved. No where can we expect this effect to be more marked than in the venous plexus of the spine, where the respiratory movements are so constantly felt, and where muscular action is so prominent in all the efforts of the trunk. From these anatomical and physiological considerations we may with justice infer that such a degree of congestion or turgescence of this spinal venous plexus as will excite irritation at the origins of the spinal nerves, may easily occur; and it appears to us that it is equally fair to conclude that such a congestion may exist *ante mortem*, and no trace of it appear *post mortem*, for to set aside all other means of accounting for the absence of the appearances, the very sections which are made to get at the supposed seat of the disease are sufficient to dissipate the venous congestion: we have stated thus much to shew that anatomy affords some support to the doctrine of *spinal irritation*, as a source of many obscure morbid phenomena, a doctrine which has been put forward with more enthusiasm than discretion, and which for that very reason has received more opposition and less dispassionate consideration than it deserved. While we would express our fullest concurrence in the wise caution which Dr. Abercrombie gives, that we should take care that this doctrine be not a *gratuitous principle* assumed so as to answer phenomena, rather than deduced from observation, we must likewise endeavour, on the other hand, to avoid setting too slight a value on observations which are supported by many respectable names, and thus falling into an error which might debar us from many an opportunity of relieving distressing and obstinate symptoms.

The most complete account of the phenomena resulting from what is called "spinal irritation" yet published, is to be found in a work by Messrs. Griffin of Limerick, on what they term "Functional affections of the spinal cord and ganglionic system of nerves." These writers are entitled to the merit of having with great industry collected many interesting cases, in all of which anomalous symptoms prevailed, and had a more or less obvious connexion with that irritable condition of the spine to which we have alluded. To enumerate these symptoms would be but to recount the numerous ills to which flesh is heir: it will suffice to state generally the result of their observations, which it is but just to say bear the internal evidence of truth and accuracy. The symptoms are in general localized to those regions of the body which receive their nervous supply from that segment of the spinal marrow that occupies the irritable portion of the spine. Thus when the cervical region of the spine is the seat of irritation, there may be painful affections of the head, the neck, the upper extremities, the respiration may be affected, or there may be pain in the chest. Some of these symptoms are of so severe a nature as to give rise to the suspicion of acute or chronic organic disease, and indeed one of the greatest difficulties connected with this subject consists in being able to dis ern when organic disease and when a simple spinal irritation gives rise to these symptoms. In some of the cases there have been fits of insensibility, paralysis, numbness of the cutaneous integument, deafness, cough and oppression, amaurotic symptoms, hesitation and difficulty of speech; all of which would at a first view of the case excite apprehension as to the existence of organic disease. Again, when the dorsal region of the spine is the seat of tenderness, there are pains about the chest or in the side, weight and constriction of the chest, cough and fits of syncope, sense of sinking, loss of appetite, vomiting, gastrodynia, pain in the region of the liver, hiccup, and where the lumbar region is affected, pains in the abdomen, dysury, or ischuria, pains in the testes or lower extremities, with disposition to paralysis. In a few cases there are symptoms resembling those above enumerated, but without any spinal tenderness; these cases were however considered and treated as cases of spinal irritation.

Females of a nervous temperament, who have passed the age of puberty and are prone to hysteria, are commonly the subjects of spinal irritation. The duration of this complaint is variable, sometimes yielding readily to the simplest treatment, and at other times resisting every mode of practice that can be devised; sometimes it yields and returns again, and so continues alternately to vanish and re-appear. It is obviously highly important that the symptoms which arise from this condition should be distinguished from those which result from organic disease as well of the spinal cord itself as of the vertebræ. According to the Messrs. Griffin, from whom (pp. 214, 15) we take the liberty of quoting the following paragraph, the symptoms which more particularly indicate spinal irritation, are

1st. The pain or disorder of any particular organ being altogether out of proportion to the constitutional disturbance.

2nd. The complaints, whatever they may be, usually relieved by the recumbent posture, always increased by lifting weights, bending, stooping, or twisting the spine, and among the poor classes often consequent to the labour of carrying heavy loads, as in drawing water, manure, &c.

3rd. The existence of tenderness at that part of the spine which corresponds with the disordered organ, and, we would add, the increase of pain in the organ by pressure on the corresponding region of the spine.

4th. The disposition to a sudden transference of the diseased action from one organ or part to another, or the occurrence of hysterical symptoms in affections apparently acute.

5th. The occurrence of fits of yawning or sneezing, which, though not very common symptoms, yet as scarcely ever occurring in acute or organic diseases, may generally be considered as characteristic of nervous irritation.

The treatment in these cases is either local or constitutional: sometimes local treatment alone rapidly removes all symptoms; but in general it is necessary to combine with it a plan of constitutional treatment calculated to regulate the digestive organs and to tranquillize the nervous system generally. Bleeding by leeches and cupping, blistering or counter-irritation by other means constitute the local treatment; the use of the cold or tepid shower-bath, the vapour-bath, or the warm-bath, may also be advisable. Change of air and scene, and indeed all remedies which tend to divert the patient's mind to other objects than himself and his sufferings, are peculiarly applicable in these cases.

Most of our readers will recollect that the coincidence of spinal tenderness with hysteria forms the subject of a small volume by Mr. Tate, in which he gives several instances of the successful employment of the friction of the back with tartar emetic ointment.* This writer, like many other practitioners, considers that the frequency of the occurrence of spinal tenderness in hysterical cases may be accounted for by a supposed connexion between the uterus and the spinal marrow. There can be no doubt that an anatomical connexion does exist between these two parts, as well through the medium of those uterine nerves, which are of spinal origin, as indirectly through the filaments derived from the sacral ganglia which inosculate with the anterior branches of the sacral nerves. Moreover it very frequently happens that symptoms of spinal irritation or more serious spinal disease rapidly make their appearance after the sudden stoppage of the menstrual flux from whatever cause. The generative system in the male seems to have somewhat a similar connexion with the condition of the spine, and we now and then read of and meet with cases in which the symptoms seemed to follow as a direct consequence upon an excessive abuse of sexual intercourse. The extreme pain and tenderness of the loins which precede a difficult menstruation or a hemorrhoidal flux, or which follow the stoppage of the latter, and which often accompany amenorrhœa, cannot be supposed to have their seat primarily in the lumbar muscles; but may, as it seems to us, be reasonably accounted for on the supposition of the existence of a vascular turgescence surrounding the branches of the lumbar and sacral nerves as they escape from the spinal foramina. This view may with equal probability be applied to account for the phenomena of spinal irritation generally, as it is obvious that a congestion affecting the nerves at their exit from the spine will be just as apt to produce the varied symptoms which we have detailed, as if the marrow itself were the congested part.

Mr. Teale adopted the doctrine of spinal irritation in explanation of many forms of neuralgia, and, as we think, with much justice. He records several cases of neuralgia of the scalp,—upper extremities, the mamma,—lower extremities, the knee, in which there was an evident connexion with spinal tenderness, and which were successfully treated by remedies applied to the spine. Mr. Teale's experience fully accords with that of the Messrs. Griffin, as well as that of Dr. Brown, who was among the first to call attention to spinal irritation in a paper which he published in the Glasgow Medical Journal for May 1828. Similar views were entertained by the late Dr. Darwall, whose opinions are recorded in a paper entitled "Observations on some Forms of Spinal and Central Irritation," and published in the Midland Medical and Surgical Reporter for May 1829.

We have thought it unnecessary in this article to enter into any statement of the views of many authors as to the degree in which the spinal marrow is engaged in many diseases of a convulsive or nervous character. Under the respective articles, CONVULSIONS, EPILEPSY, HYDROPHOBIA, TETANUS, the reader will find this fully treated of.

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* Tate on Hysteria.